Nigerian Food Journal
Official Journal of Nigerian Institute of Food Science and Techonology www.nifst.org
NIFOJ Vol. 30 No. 1, pages 109 – 115, 2012

Physical, Chemical and Sensory Properties of Baked Products from Blends of Wheat and African Yam Bean (*Sphenostylis stenocarpa*) Water-Extractable Proteins

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ABSTRACT

Blends of wheat flour (WF) and African yam bean water-extractable proteins (AYBWEP) were processed into bread and cookies in the following ratios: 100: 0; 95: 5; 90: 10; 85: 15; 80: 20. The proximate composition, physical, chemical properties and sensory properties of bread and cookies samples from the blends were determined. Breads and cookies produced from the resultant blends were significantly higher ($p < 0.05$) in protein (16.39% – 18.36%) than the control (11.80% – 12.58%). Carbohydrate content decreased from 60.74% with addition of AYBWEP to 52.81% following 20% substitution. The pH of bread samples prepared from whole wheat flour and blends of wheat flour and AYBWEP were significantly different ($p < 0.05$) while bulk density and specific volume were not significantly different ($p > 0.05$). The pH of bread samples and cookies decreased with increase in the proportion of the AYBWEP blend from 5% to 20%. The highest specific volume (3.70ml/g) was observed in bread samples prepared from the control 100: 0 blends while the 80:20 blends had the lowest specific volume (3.10 ml/g). There was no significant difference ($p > 0.05$) in the bulk density and thickness of the cookies. The cookies prepared using 80: 20 blends had the higher diameter (22.53 cm) and spread factor (54.03 cm) compared to the control. Generally, acceptability of the bread and cookies decreased with higher ratios of AYBWEP inclusion. The sensory acceptability scores showed the best AYBWEP substitution level for making bread and cookies was 5% and 10% of the AYBWEP respectively. The results are discussed in the context of the growing importance of promoting the processing and utilization of lesser known local crops in baked products.enrichment.

Keywords: Wheat flour substitution, African Yam Bean water-extractable proteins, bread, cookies, physical, chemical and sensory properties.

Introduction

In most parts of the world, baked goods, based on wheat flour in particular, are popular foodstuffs. The consumption of these products has been consistently increasing in countries like Nigeria (Edema *et al*., 2005). Reports indicate that the price of wheat flour rose from $200.00 per ton in 1996 to $400.00 in 1999 (Kessel, 2003). Wheat as a major source of raw material for the production of these baked products also lacks some nutrients. Blends of flours using protein concentrates from legumes are desirable in cereal flours not only for increasing the quantity of protein but because they also increase the levels of some amino acids, especially lysine which is normally lacking in the flour (Ihekoronye and Ngoddy, 1985).

The potential use of composite flours for bread and cookies making has been evaluated by several authors. Agu *et al*. (2007) reported the use of composite flour of wheat and African breadfruit in biscuit-making.

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Wheat flour was also replaced with cowpea flour at various levels for the production of baked products such as bread (McWatters *et al*., 2004) and cakes (Akubor, 2004). Also, Akpapunam and Darbe (1994) reported the production of cookies from blends of maize and Bambara groundnut.

African yam bean (*Sphenostylis stenocarpa*), a lesser-known legume, grows along with yam and cassava. It can be used extensively in various dietary preparations and supplementation of the protein requirements of many families throughout the year. However, the legume's potential is largely unexploited, due to its characteristic problem of hard to cook phenomenon, poor digestibility and flatulence.

According to Abu and Minnaar (2005), legume protein and starch concentrates rather than their corresponding flours are employed in food products owing to reasons of better functionality of the concentrates, as well as enhanced elimination of anti-nutritional factors. In this study, the effect of substituting wheat flour with African yam bean water-extractable proteins on the physicochemical and sensory properties of bread and cookies was determined.

Material and Methods

Source of materials

The cream coat African yam bean (*Sphenostylis stenocarpa*) used in this study was purchased from Chikwan market in Cross River State. The equipment used came from Food Science and Technology department, Federal University of Agriculture Makurdi and Benue Brewery Limited, Makurdi, Benue State.

Preparation of African yam bean flour

The African yam bean flour was prepared according to the modification of methods described by Enwere (1998). The cleaned African yam bean seeds were soaked in water (30°C, 12 h) and dehulled manually. Dehulled seeds were drained and dried (600C, 10 h) to less than 10% moisture in the hot air oven (Genlab widness, Model T12H). The dried cotyledons were allowed to cool and milled into flour using laboratory attrition mill (Atlas model ED-5).

Preparation of African yam bean water-extractable proteins

Water-extractable proteins were prepared from African yam bean flour following the methods cited in Abu *et al.* (2007). African yam bean flour (200 g) was mixed in deionized water (200 ml) and only stirred using a 78-1 magnetic stirrer hotplate for 60 min at ambient tempreature. The resultant solution was kept in a fridge (4°C, 30 min) for insoluble materials to sediment. The supernatant was decanted and centrifuged (2500 g, 30 min) using a minor centrifuge (MSE England). The supernatant was dried in a hot air oven (45°C, 48 h) to obtain dry flakes, which were then milled using a blender (HR 1702) to obtain powdered water-extractable proteins. The water-extractable proteins were analyzed for moisture and protein following AOAC (2000) methods.

Baking process

The five blends of wheat/African yam bean flours used were 100/0; 95/5; 90/10; 85/15; and 80/20 for both bread and cookies preparations. Bread and cookies were prepared according to the methods described by Balami *et al.* (2004) and Nishibori and Kawakishi (1990) respectively.

Proximate analysis

The moisture, crude protein, fat, crude fiber and ash contents were determined following the procedure outlined by AOAC (2000), while carbohydrate was calculated by difference (Kirk and Sawyer, 1997).

Physical and chemical analysis

The flour blends analysed for pH, bulk density and gelation capacity were determined using standard methods (Onwuka, 2005) while swelling index was based on the method reported by Sathe and Salunkhe (1981). In addition, the physical and chemical properties of the composite breads and cookies were determined using standard methods. The breads were analyzed for bulk density, pH, loaf volume and specific volume using standard methods (Onwuka, 2005; NSO, 1979). For the